AD-732 608

MORTARS

Albert N. Garland

Army Test and Evaluation Command
Aberdeen Proving Ground, Maryland

18 July 1972

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)
United States Army Infantry Board
Fort Benning, Georgia 31905

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP

3. REPORT TITLE
U. S. Army Test and Evaluation Command
Expanded Service Test - System Test Operations Procedures
Mortars

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Final

5. AUTHOR(S) (First name, middle initial, last name)
Mr. Albert N. Garland

6. REPORT DATE
18 July 1972

7a. TOTAL NO. OF PAGES
44

7b. NO. OF REFS
22

8a. CONTRACT OR GRANT NO.

b. PROJECT NO. AMSTE-RP-702-102

c.

d.

9a. ORIGINATOR'S REPORT NUMBER(S)
TOP 3-3-050

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

10. DISTRIBUTION STATEMENT
Approved for public release; distribution unlimited.

11. SUPPLEMENTARY NOTES

12. SPONSORING MILITARY ACTIVITY
Headquarters
US Army Test & Evaluation Command
Aberdeen Proving Ground, Maryland 21005

13. ABSTRACT

Describes a method for evaluation of mortar operational and functional performance characteristics. Identifies supporting tests, facilities, and equipment required. Provides procedures for personnel training, disassembly, assembly, mounting, dismounting, manipulation, removal of misfires, suitability, fire adjustment, range, accuracy, rate of fire, tactical employment, effectiveness, durability, reliability, transportability, maintainability, and value engineering.

1

AD 752 65

DD FORM 1473 REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE

Security Classification

44

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Mortar Vehicular Mounted Weapons Weapon Effectiveness Weapon Effects Weapon, Vehicle Mounted						

U. S. ARMY TEST AND EVALUATION COMMAND
EXPANDED SERVICE TEST - SYSTEM TEST OPERATIONS PROCEDURES

AMSTE-RP-702-102
*Test Operations Procedure 3-3-050 18 July 1972

AD752608

MORTARS

SECTION I
GENERAL

1. Purpose and Scope. The test operations procedures described herein are intended to apply to the expanded service testing of a mortar

*This TOP supersedes MTP 3-3-050, 3 July 1970, and 3-3-052, 14 May 1970.

Approved for public release; distribution unlimited.

DDC
RECEIVED
DEC 18 1972
B

which consists of a barrel or tube, a mount composed of either a tube support or a bipod, a baseplate, and a sight unit. (This TOP does not prescribe the procedures used in testing the sight unit; the procedures for testing the sight unit are contained in TOP 3-3-067 Sight, Indirect Fire.) These procedures also apply to the testing of a mortar trainer, a device which permits training to be accomplished when ammunition allowances and range limitations restrict training to sub-caliber firing on reduced ranges or to the conduct of simulated firing exercises.

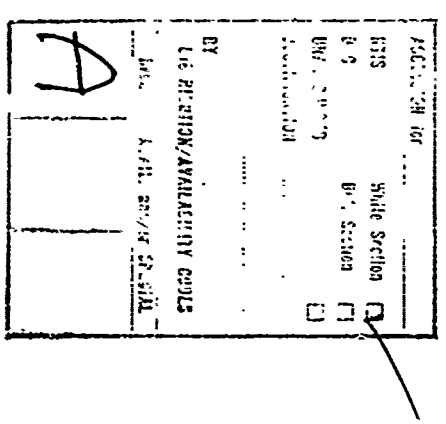
With appropriate but minor modifications, these procedures can also be used to conduct an expanded service test of a carrier-mounted mortar. A series of supporting tests for the carrier-mounted mortar is included in appendix B.

The tube or barrel of a mortar may be smooth-bore or rifled, and may contain either a baseplug and firing pin or some other kind of firing mechanism. The baseplate may contain a socket in which the tube or barrel baseplug will fit, and spades on the botton to provide solid ground support.

The primary objectives of these test procedures are to provide the means by which a test officer can determine whether a test mortar and its training and maintenance packages, or a mortar trainer and its training and maintenance packages, meet the criteria contained in the appropriate requirements documents, and if the test weapon or test mortar trainer are suitable for use by the United States Army. Current standard mortars and mortar trainers should be used for comparison and control purposes.

The environmental conditions applicable to this document are those associated with climatic categories 5 and 6 specified in AR 70-38, Research, Development, Test and Evaluation of Materiel for Extreme Climatic Conditions. As used herein, the night environment is defined as: full moon, 1×10^{-2} to 4×10^{-2} foot candles· half-moon, 1×10^{-3} to 4×10^{-3} foot candles· starlight, 1×10^{-4} to 4×10^{-4} foot candles: overcast, 1×10^{-5} to 4×10^{-5} foot candles· dawn and dusk, 1 to 10 foot candles· and twilight, 1×10^{-1} to 10 foot candles.

2. Background. In one form or another, mortars have been part of the U.S. Army's inventory for many years. And even though today's standard mortars are excellent weapons, continued technological and materiel advances require the Army to seek even better mortars, more effective, efficient, and powerful.



4

In its search for a better mortar, the Army seeks a weapon that is rugged, simple, stable, and of the lightest possible weight. The mortar must be accurate; it must be so designed that it can be broken down into easily assembled and disassembled man-portable loads: a crew manning the mortar must be capable of engaging targets at the designated ranges (including minimum and maximum ranges) using both direct and indirect laying procedures· and the aiming and firing procedures developed for use by mortar crews must be uncomplicated and capable of rapid completion. The mortar must be so designed that only a minimum number of personnel are required to serve the weapon.

Several types of training devices have been developed, none of which has proved to be completely satisfactory. The ideal mortar trainer should permit realistic and effective training in individual and crew skills, particularly in fire adjustment. The training activities so conducted should closely approximate actual crew drill and field firing.

3. Equipment and Facilities.

a. Test mortars, mortar trainers, and accessories.

b. Control mortars, mortar trainers, and accessories.

c. Training and maintenance test packages.

d Ammunition, both service ammunition and training cartridges.

e. Photographic equipment, including still, motion picture and television cameras.

f. Communications equipment.

g. Wheeled and tracked vehicles.

h. Military aircraft, both fixed and rotary wing.

i. Cleaning materials and lubricants.

j. Meteorological instrumentation.

k. Aiming circles.

l. Binoculars.

m. Plotting boards.

n. Sight units.

o. BC scopes.

p. Stopwatches.

q. Photometer.

r. Safety and first aid equipment.

s. Suitable firing ranges, instrumented and otherwise.

t. Suitable tactical field exercise areas, including drop and landing zones.

SECTION II
TEST PROCEDURES

4. Supporting Tests. Published MTP's/TOP's and the subtests listed below -- further defined where necessary in Section III -- should be considered in formulating and developing an expanded service test plan. Additional reference material is listed in appendix A.

In his preparations for the test, the test officer should conduct the necessary administrative, personnel, and supply preliminaries outlined in his test officer guide or manual, or in his unit or organizational standard operating procedures. He must keep in mind the fact that sufficient pretest training must be accomplished to ensure that the test soldiers are equally familiar with the test and control items. It is extremely important that the performance of the test mortar and test mortar trainer not be degraded because the test troops were unfamiliar with the particular test item.

The test officer must also ensure that during each of his supporting tests sufficient data must be collected to enable him to arrive at valid conclusions. To determine the best way to collect sufficient data, the test officer should consult with a statistical analyst to develop an experimental design prior to preparing his test plan, since a proper experimental design will aid in the control of bias. Statistical guidance can be found in TOP 3-1-002, Confidence Intervals and Sample Size, and in National Bureau of Standards Handbook 91, Experimental Statistics.

If possible, the test officer should also consult with human factors personnel for assistance in the preparation of pertinent portions of his test plan and test reports, and for the development of interview and questionnaire items.

	TEST TITLE	REFERENCE PUBLICATIONS
(1)	Preoperational Inspection and Physical Characteristics	MTP 3-3-500
(2)	Safety	MTP 3-3-517
(3)	Personnel Training (refer to para 5)	MTP 3-3-501
(4)	Disassembly, Assembly, Mounting, and Dismounting (refer to para 6)	
(5)	Manipulation, Mortar (refer to para 7)	
(6)	Removal of Misfires, Mortar (refer to para 8)	
(7)	Stability, Mortar (refer to para 9)	
(8)	Fire Adjustment, Range, and Accuracy, Mortar Trainer (refer to para 10)	
(9)	Accuracy, Mortar (refer to para 11)	
(10)	Rate of Fire (refer to para 12)	
(11)	Tactical Employment, Mortar (refer to para 13)	
(12)	Realism, Versatility, and Effectiveness, Mortar Trainer (refer to para 14)	
(13)	Durability and Reliability (refer to para 15)	

TEST TITLE	REFERENCE PUBLICATIONS
(14) Security from Detection, Mortar	TOP 1-3-515
(15) Adverse Conditions, Mortar	MTP 3-3-524
(16) Transportability, Mortar (refer to para 16)	
(17) Maintainability (refer to para 17)	
(18) Human Factors Engineering and Troop Acceptability	MTP 3-3-521
(19) Value Engineering (refer to para 18)	

SECTION III
SUPPLEMENTARY INSTRUCTIONS

5. Personnel Training.

a. Mortar.

(1) MTP 3-3-501, Personnel Training, outlines the general procedures that should be followed to determine the type and duration of the instruction required to train test soldiers in the use of the particular test item, whether a proposed program of instruction (POI) is adequate to develop proficiency in the use of a test item, and whether the test item meets the training criteria contained in the appropriate requirements documents.

(2) The test officer must ensure that the test soldiers clearly understand what is to be accomplished by the testing program. Further, if he determines that the test soldiers are already familiar with the control mortar, he then knows he must place additional emphasis on their training with the test mortar to overcome any bias caused by previous use or familiarization.

(3) When assessing the training package, if the test officer should determine that the proposed POI is inadequate, he should draw therefrom specific conclusions and formulate detailed recommendations for improving the adequacy of the POI.

b. Mortar Trainer.

(1) Except for portions of the supporting test described in paragraph 14 below, the test soldiers should be fully qualified mortar gunners and mortar crewmen.

(2) Throughout the period of training, the test officer should note any difficulties encountered, and the time required to orient and familiarize the test crews prior to conducting operational training exercises.

(3) As with the mortar, sufficient pretest training must be conducted to insure that the test soldiers are equally familiar with the test and control mortar trainers.

6. Disassembling, Assembling, Mounting, and Dismounting.

a. Objective.

To determine the time required and any problems associated with disassembling, assembling, mounting, and dismounting the mortar or mortar trainer.

b. Method.

(1) Disassembling and Assembling

(a) The appropriate operator and technical manuals should be consulted to determine which parts of the test mortar or test mortar trainer can be disassembled and assembled by the mortar crews, and which parts by unit or organizational armorers.

(b) Test mortar or test mortar trainer crews should disassemble those parts so designated as their responsibility in the operator and technical manuals, and should then repeat the process on the control mortars or mortar trainers.

(c) Unit or organizational armorers should also disassemble those parts of the test mortars or mortar trainers designated as their responsibility, and should repeat the process on the control mortars or mortar trainers.

(d) When sufficient data has been collected on disassembly, test crews should then assemble those same parts on the test mortars or

trainers, and should repeat the process on the control mortars or trainers.

(e) Unit or organizational armorers should also assemble those parts on the test mortars or trainers designated as their responsibility, and should repeat the process on the control mortars or trainers.

(f) Disassembly and assembly procedures should be accomplished under adverse as well as ideal climatic conditions.

(2) Mounting and Dismounting

(a) Following the guidance given in the operator's manual, test crews should mount the test mortar or test mortar trainer, and should then repeat the mounting process with the control mortar or mortar trainer.

(b) When sufficient data on mounting the mortar or mortar trainer has been acquired, test crews should then dismount the test mortar or trainer, and should repeat the dismounting process with the control mortar or trainer.

(c) Mounting and dismounting exercises should be conducted during daylight hours and during the hours of darkness in all types of prevailing weather conditions.

c. Data Required.

(1) Times required by test crews and by unit or organizational armorers to disassemble the mortar or mortar trainer parts for both the test and control mortars or the test and control mortar trainers.

(2) Times required by test crews and by unit or organizational armorers to assemble mortar or mortar trainer parts on both the test and control mortars or mortar trainers.

(3) A record of any particular difficulties encountered by the test crews and by the unit or organizational armorers in disassembling or assembling the parts of either the test and control mortars or the test and control mortar trainers.

(4) Times required by test crews to mount, and then to dismount, the test and control mortars or the test and control mortar trainers.

(5) A record of any particular difficulties encountered by the test crews in mounting and dismounting the test and control mortars or the test and control mortar trainers.

d. Analytical Plan.

(1) Comments and observations concerning disassembling, assembling, mounting, and dismounting of both the test and control items should be subjectively evaluated.

(2) All other collected data should be evaluated to determine whether the criteria specified in the requirements documents have been met.

7. Manipulation (For Mortar Only).

a. Objective.

To determine the manipulation characteristics of the test mortar relative to the operation of handwheels, adjustments, and supports.

b. Method.

(1) Once the test mortars have beem emplaced on a firing line on an appropriate firing range, the test officer should conduct various manipulation exercises to determine:

(a) The traverse capability to the left and to the right, and the maximum elevation capability of the test mortar.

(b) The ability to manipulate the test mortar, to include both small and large shifts within the limits of the traversing mechanism.

(c) The ability to manipulate the test mortar when it becomes necessary to shift the direction of fire outside the traversing mechanism limits.

(d) The number of mils change in elevation and in traverse as the result of one turn of the appropriate handwheel, and any lost motion noticed during the turn.

(e) A record should be kept of the sight throw-off in direction which results from the cant induced in the test mortar when elevating from minimum to maximum elevation, and the cross-leveling correction required.

(f) A record should be kept of the sight throw-off in elevation which results from the cant induced in the test mortar when traversing from center to left and center to right, and the cross-leveling correction required.

(g) Notation should be made of the amount of adjustment required to change from the maximum to the minimum range.

(2) When sufficient data on the test mortar has been obtained from the above exercises, the test officer should then have the test crews repeat the exercises using the control mortars.

(3) Comparative manipulation exercises should be determined by using the mortar attitudes contained in the preliminary operating and maintenance manual (POMM), or in the provisional handbook, for the mortar being tested.

(4) Manipulation exercises should be conducted both during the hours of daylight and the hours of darkness.

c. Data Required.

(1) A record of the total traverse capability and the average traverse change in mils provided for each full turn of the traversing handwheel.

(2) A record of the total elevation capability and elevation change in mils provided for each full turn of the elevation handwheel

(3) A record of the ease of manipulation, the average times required, and the number of men needed to manipulate the mortar during the various prescribed shifts.

(4) A record of the sight throw-off in deflection and elevation and the cross-leveling required.

(5) A record of the adjustment required to change from the minimum to maximum range.

(6) A description of the test mortar attitudes used, sights employed, and elevations.

(7) A record of the smoothness of gear operation in elevation and traverse, and the smoothness of operation using both coarse and fine adjustments of the cross-leveling mechanism.

(8) A record of the amount of handwheel effort required throughout the entire elevation and traverse.

(9) A record of any inconveniences caused by the location of the handwheels, taking into account the possibility of interferences between the hand of the gunner and the tube support or the traverse yoke.

d. Analytical Plan.

(1) Comments and observations concerning manipulation of both the test and control mortars should be subjectively evaluated.

(2) All other collected data should be evaluated to determine whether the criteria specified in the requirements documents have been met.

8. Removal of Misfires (For Mortar Only).

a. Objective.

To evaluate the safety aspects associated with removing a misfire from the test mortar.

b. Method.

(1) Using the test mortars only, and following the procedures outlined in the operator's manual, all test crew members should be required to remove simulated misfires using dummy rounds from the mortar tubes, rotating positions until each man has served in a different crew position.

(2) When sufficient data has been collected on the removal of misfires from the test mortars, the exercises should be repeated using the control mortars.

c. Data Required.

(1) A record of the time required to remove the misfires from both the test and control mortars.

(2) A record of the ease and safety of the removal of the misfires from both the test and control mortars.

(3) A record of any problems noticed during the removal of the simulated misfires, and whether any deviation from the prescribed procedures outlined in the operator's manual was necessary.

d. Analytical Plan.

(1) Comments and observations concerning the removal of misfires from both the test and control mortars should be subjectively evaluated.

(2) All other collected data will be evaluated to determine whether the criteria specified in the requirements documents have been met. If deemed necessary and desirable by the test officer, a modified misfire removal technique should be developed and recommended for adoption.

9. Stability (For Mortar Only).

a. Objective.

To determine the manner and the degree to which the test mortar retains its lay during firings under a range of conditions representative of mortar usage.

b. Method.

(1) The test and control mortars should be emplaced on identical, level surfaces. If used, reinforcing expedients such as logs and sandbags should be described and photographed; they should also be employed to an equal degree with both the test and control mortars.

(2) After the baseplates have been firmly seated, both the test and control mortars should be fired in a series of exercises which combine the following conditions.

(a) Traverse -- maximum left, maximum right, and center.

(b) Charge -- maximum, intermediate, and minimum.

(c) Range -- maximum, intermediate, and minimum.

(d) Soil -- varied, such as sandy, loam, clay, rocky, shallow, deep.

(e) Cartridge group -- to be determined from requirements documents.

(3) Note the total vertical and horizontal baseplate displacement during seating of the baseplate and during the firing exercises, and sight throw-off during the firing exercises. Extensive use should be made of direct measurements and photography to record such displacement.

(4) After sufficient data has been collected from the level firing exercises, the test and control mortars should be emplaced in identical positions on various degrees of slopes, and the firing exercises repeated. The firing exercises should also be conducted with the mortars emplaced on sand, on mud, on very hard ground, and fired from unprepared positions. After each firing exercise, notation should be made of baseplate displacement, if any, and sight throw-off, if any, the type cartridges fired, the charge used on each cartridge, and the elevation of the tube for each cartridge.

(5) During the firing exercises, the test supervisory personnel should make careful note of the seating of the baseplate and should record the following:

(a) Seating adequacy on unprepared soil

(b) The necessity to use field expedients

(c) Preparations made to the various firing positions

(d) The number of rounds required to seat the baseplate in each of the various types of soil

(e) Any comments relative to the ease or difficulty of seating the mortars should be noted.

(6) If the constraints are such as to preclude the conduct of this supporting test, the stability of the test mortar should be determined during the conduct of the other supporting tests, such as accuracy and rate of fire.

c. Data Required

(1) Any information pertaining to stability which might have been derived from other supporting tests.

(2) The sight throw-off and baseplate displacement occuring while firing the mortars under the various test conditions, and the type cartridges fired, the charge used on each cartridge, and the elevation of the tube for each cartridge.

(3) Information on and the necessity for using reinforcing expedients.

(4) Seating adequacy on slopes and on unprepared soils, to include the types of soil.

(5) The preparations made to the firing positions, if any.

(6) The number of rounds required for each seating.

(7) Comments from the test soldiers and from test supervisory personnel on the ease or difficulty in seating the baseplate.

d. Analytical Plan.

All collected data should be subjectively evaluated to determine whether the criteria specified in the requirements documents have been met.

10. Fire Adjustment, Range, and Accuracy (Mortar Trainer Only).

a. Objectives. The objectives of this subtest are to determine:

(1) The effectiveness of fire adjustment.

(2) The range of the projectiles fired and training area requirements.

(3) The accuracy and dispersion pattern of the projectiles fired, and the accuracy of the accompanying firing tables.

(4) Traverse, elevation, and change adjustment capabilities and limitations.

b. Method.

(1) Prepare the test area, placing targets, aiming stakes, and any other equipment as required to support the test trainer.

(2) Station test and control mortar trainers at various surveyed firing positions which will permit the trainers to be fired at all ranges from minimum to maximum, and at which deflection exercises can be conducted while firing. Firing tables provided with the test trainers should be used, and all applicable charges should be fired.

(3) A number of rounds from the test and control trainers should be fired in accordance with the instructions contained in the appropriate training manuals and firing tables. The number of rounds to be fired should be determined from the statistical evaluation performed during the pretest preparation planning period.

(4) Firing exercises should be repeated for the various groups of charges.

c. Data Required.

(1) Impact coordinates for each group of cartridges.

(2) The range probable error and deflection probable error for each group of cartridges.

(3) The number of rounds fired at each range; the ranges to targets; the firing table ranges: and the charge used on each cartridge.

(4) Meteorological conditions throughout the firing periods, taken at hourly intervals.

(5) Fire adjustments (forward observers' request and corrections), and fire commands from fire direction center to gun locations.

(6) Malfunctions or other occurences which have a bearing on the results of the firing exercises.

(7) A description of training area requirements.

d. Analytical Plan.

(1) Calculate the mean range probable error and mean deflection probable error and determine an appropriate lower confidence limit for

each. Perform an appropriate statistical test to determine if a significant difference exists between the mean range probable error and the mean deflection probable error for the test and control trainers.

(2) Comments by test soldiers and observations by test supervisory personnel should be subjectively evaluated to determine if there is a significant difference in the ease of use between the test and control trainers.

(3) All collected data should be evaluated to determine the training area requirements for the test mortar trainer, and a comparison should be made with the requirements for the control mortar trainer.

11. Accuracy (For Mortar Only).

a. Objective.

To determine if the test mortar meets the criteria established for range and deflection probable errors.

b. Method.

(1) General Procedures.

(a) All rounds of a mean point of impact (MPI) group should be fired under the same environmental conditions.

(b) MPI groups should not be fired when the ambient conditions are irregular, i.e., high gusty winds, rapid changes during frontal passages, and the like.

(c) Rounds should be fired at a deliberate rate to avoid the buildup of heat in the tubes and to minimize the effects of weather changes.

(d) The rounds of ammunition should not be allowed to remain in the tube for periods longer than 2 minutes.

(e) All ammunition to be fired should be taken from the same lot number, and provisions should be made to insure the ammunition is properly stored at all times.

(f) Appropriate firing tables, standard or provisional, should be available at each firing position.

(2) Pre-firing procedures:

(a) Firing positions should be selected and surveyed so that the test and control mortars can be fired at short range, midrange, and long range from identical surfaces. Cartridge groups should be fired alternately from the test and control mortars.

(b) To determine the impact location of each projectile, a minimum of three flash observation posts should be surveyed to an accuracy of 1/3,000. Caution should be exercised in the selection of these positions to ensure that the observers can see the burst of each round, not just rising or blowing smoke.

(c) MTP 3-2-825, Location of Impact or Airburst Positions, can be used as a guide in establishing the observation stations and the methods to be used in observing and recording the projectile impacts or bursts. It is possible for those procedures to be supplemented by radar, motion pictures, or geophones, if such are available and can be readily installed on an appropriate range.

(d) The firing positions and the impact area for each MPI group should be on approximately level or gently sloping ground.

(3) Firing Procedures:

(a) Base plates should be properly seated and normal prefiring checks accomplished.

(b) Three cartridge groups should be fired, on at the extreme left traverse, one at the extreme right traverse, and one at the center traverse position, with the gunners relaying the mortars after each cartridge. The groups should be fired at short ranges, midranges, and long ranges.

(c) The point of impact for each cartridge should be recorded as shown in MTP 3-2-825.

(d) The sight unit should remain mounted on the mortar during all firing in this subtest.

c. Data Required.

(1) Grid coordinates of each observation post.

(2) Instrument readings from each observation post to each point of impact.

(3) Center of impact for each cartridge group.

(4) Range probable error.

(5) Deflection probable error.

d. Analytical Plan.

(1) Deflection and range probable errors for each cartridge group should be computed by one of two methods -- standard deviation or successive differences.

(2) If trends existed during the firing tests, such as a constantly increasing wind, the successive differences method should yield the best estimate of probable errors. If no trends were present, the standard deviation method should yield the best results. If large differences exist between the two methods, the results should be carefully examined and the causes investigated.

(3) The mean range probable error and mean deflection probable error should be calculated and an appropriate lower confidence limit determined for each. An appropriate statistical test should be performed to determine if a significant difference exist between the mean range probable error and the mean deflection probable error for the test and control mortars.

(4) Comments by test soldiers and by test supervisory personnel should be subjectively evaluated to determine if the test mortars demonstrate a significant difference in ease of use.

12. Rate of Fire.

a. Objectives.

(1) To determine if the crew of a test mortar can conduct sustained fire at the rate of fire stated in the requirements documents.

(2) To determine if the crew of a test mortar can conduct the maximum rate of fire, within the physical capabilities of the crew, for a specified period of time.

(3) For the mortar trainer, to determine whether the test trainer will permit the gunner to operate and manipulate the device while the trainer is being fired at a sustained rate of fire.

b. Method.

(1) For the mortar trainer:

(a) The test mortar should be fired at a sustained rate of fire for a specified period of time at a specified rate of fire.

The rate of fire should be determined from the operating instructions or the requirements documents which accompany the test trainer.

(b) The test trainer should be set in its maximum elevated position, and the maximum service charge should be used.

(c) During one series of exercises, the gunner should not be required to perform any manipulation exercises. During another series, the gunner should be required to manipulate the test trainer.

(d) During the course of the various firing exercises, a record should be kept of each mortar trainer crew's ability to conduct sustained fire, and of the gunners' ability to conduct manipulation exercises during the conduct of sustained fire.

(2) For the morter:

(a) Prior to firing the exercises listed below, the mortar emplacements should be reinforced to the extent necessary to insure adequate stability.

(b) A specified number of cartridges should then be fired from the test mortar at an appropriate range as rapidly as possible, for a specified period of time, relaying after each cartridge. The exact number of cartridges in this group and the exact period of time should be specified in the appropriate requirements documents. The rate of fire achieved will be recorded. This exercise should be fired by each of three test soldiers.

1. Since the capability to maintain the sustained rate of fire indefinitely is contingent on the capability of the mortar tube to withstand the resulting temperatures, that capability can only be established through an instrumented engineering test. See MTP 3-2-050, Mortars, for the various engineering tests used to determine the functioning capabilities of mortars under various operating conditions.

2. The firing exercises described above should be repeated with the control mortar, under like conditions.

(c) The test and control mortars should then be fired at minimum elevation and maximum charge at the maximum rate of fire, without relaying the mortar within the physical capabilities of the mortar crew, for a specified period of time, usually for 1 minute. The area covered,

base plate displacement, sight throw-off, and rate of fire should be recorded.

1. The maximum rate of fire exercise should be repeated with the mortar set at maximum elevation and with the minimum charge being used. During this exercise, the sight unit should remain on the mortar and the gunner should retain the lay of the mortar to the extent possible while the mortar is being fired.

(d) Special attention should be given throughout all the firing exercises to detect effects on personnel attributable to blast, flash, or smoke on the mortar squad or on the fire control equipment.

(e) If at all possible TV recordings and colored motion pictures should be taken of all firing exercises conducted during this supporting test.

c. Data Required.

(1) For the mortar trainer:

(a) The number of rounds fired, the elevation set on the trainer, and the charges used.

(b) The duration of the sustained fire period, the wind speed, and the direction of the wind.

(c) The range to the point of impact for each round, the deflection to the point of impact for each round, and any malfunctions or other occurrences having a bearing on the test results.

(2) For the mortar:

(a) The time required to fire the specified number of cartridges, and the rate of fire.

(b) A comparison of the speed of firing when using the test and control mortars.

(c) The number of cartridges fired in each exercise.

(d) The effects of blast, smoke, and flash on visibility, operation of fire control equipment, and members of the firing crews

(e) The range probable error, deflection probable error, and center of impact for each cartridge group.

(f) The temperature, wind speed and direction, and any inclement weather conditions encountered during the firing of each cartridge group.

(g) The total base plate displacement and sight throw-off after each cartridge group has been fired.

d. Analytical Plan.

(1) For the mortar trainer:

All data collected during this supporting test should be collated and reduced to concise, workable form. The data should then be analyzed to identify any deficiencies or shortcomings to determine if the test objectives were met and if the test trainer meets the established requirements criteria.

(2) For the mortar:

(a) A subjective evaluation should be made to determine if the test mortar is safe to fire at all ranges at the maximum rate of fire within the physical capabilities of a mortar crew for a particular period of time under all climatic conditions.

(b) Both a subjective and an objective evaluation should be accomplished to determine if the test mortar can be fired for an indefinite period of time at all ranges and with the accuracy specified as being essential.

1. Accuracy computations can be accomplished as outlined in paragraph 11d, above.

2. Comments by test soldiers and observations by test supervisory personnel should be subjectively evaluated to determine if the test mortars demonstrate a significant difference in ease of use.

13. Tactical Employment (For Mortar Only).

a. Objective.

To determine if the test mortars, under tactical field firing conditions, meet the accuracy and other specified criteria contained in the requirements documents.

b. Method.

(1) This supporting test should extend over an appropriate period of time and should be conducted under tactical field conditions. It should include a series of tactical exercises.

(2) Test mortar squads should be thoroughly trained in the operating characteristics and the tactical employment of both the test and control mortars.

(3) This test should be conducted a minimum of 2 times to permit a changeover of mortar squads to take place, so that each squad uses the test mortar, and each squad uses the control mortar.

(4) A suggested series of tactical exercises is found in appendix C.

(5) Prior to firing each cartridge group, the mortar sights should be calibrated as explained in the appropriate mortar field manual. After each fire mission the sight should be recalibrated and any deviation in azimuth and elevation noted.

c. Data Required.

(1) The ease of handling and any difficulties encountered.

(2) The ease and time required to place the mortars in and to take the mortars out of action.

(3) The ease and time required to register, and the number of cartridges required for registration.

(4) The time required to complete each fire mission.

(5) The range to center of impact, the probable deflection error, and the probable range error of the fire for effect of those exercises not requiring traversing fire techniques.

(6) The ease of maintaining the lay of the mortar during firing.

(7) The total baseplate displacement and sight throw-off after the firing of each cartridge group.

(8) The compatibility of the protective mask and hood with the test and control mortars.

(9) The ease and speed with which the test and control mortars can be laid during the hours of darkness.

(10) The types and conditions of the soil on which the mortars were emplaced.

(11) The temperature, wind speed and direction, and any inclement weather conditions during each firing exercise.

(12) The compatibility of the HE, WP, and illuminating cartridges with the test mortar.

(13) Any loss of sight calibration for azimuth and elevation.

d. Analytical Plan.

(1) Data relative to the ease of handling, the ease and speed of placing the mortar in action and taking the mortar out of action, the ease and speed of registering, the rate of fire during those firing exercises which required rapid firing, the ease of maintaining the lay of the mortar during firing, the compatibility of the mask and hood with the mortars, the ease and speed with which the mortars can be used during the hours of darkness, and the compatibility of the HE, WP, and illuminating cartridges with the test mortar, and the frequency, degree, and cause of lost sight calibration should be evaluated to determine if the established requirements have been met.

(2) The accuracy attained by the mortar crews during the field tactical firing exercises should be obtained by using the procedures outlined in paragraph 11d, above.

14. Realism, Versatility, and Effectiveness (Mortar Trainer Only).

a. Objectives.

(1) To determine how closely training activities approximate actual drill activities, adjustment firing data computations, and firing exercises.

(2) To determine the number of skills which can be effectively practiced with the test mortar trainer.

(3) To determine the overall effectiveness of the test mortar trainer as an aid to training.

b. Method.

(1) Using the mortar trainer, test soldiers who are not qualified mortar crewmen should be given training in observer, fire control, and crew skills. This training period should be followed by firing exercises with the actual mortar and live ammunition.

(2) Test soldiers who are experienced mortar crewmen should be given refresher training exercises with the test trainers and then should be questioned as to whether the test trainer would aid them in maintaining their efficiency in mortar skills.

(3) Throughout all the supporting tests, supervising personnel should evaluate the test trainer's overall effectiveness as a training aid. The evaluation should include the following:

(a) How closely the physical characteristics of the trainer approximate that element or those elements of the mortar it is designed to represent.

(b) Whether the prescribed procedures in the applicable field manuals can be closely followed.

(c) The degree to which each crewman's activities approximate the activities involved in actually firing a mortar.

(d) The amount of realism in the adjustment of fire and in fire control procedures.

(e) The specific skills the test trainer will help to teach.

(f) The overall usefulness of the test mortar trainer in teaching all aspects of mortar gunnery.

(g) The phases of training for which the test mortar trainer are most effective -- basic individual skills, crew drill, squad drill, section drill

(h) The types of mortars for which the test trainer will provide effective training.

c. Data Required.

(1) For test soldier trainees, the number of test soldiers, the types and time durations of the training periods, and the observations

of the test supervisory personnel regarding the effectiveness of the test mortar trainer as an aid to basic mortar training.

(2) For the experienced mortar crewmen, the number of crewmen given refresher training, the types and time durations of the refresher exercises, and the opinions of the crewmen regarding the effectiveness of the test trainer as an aid in maintaining mortar efficiency.

(3) A record of all pertinent observations regarding the specific characteristics and objectives listed in this supporting test.

d. Analytical Plan.

(1) The data collected should be subjectively evaluated to determine if the stated criteria for the test mortar trainer have been met and if the test and control items differ significantly in realism, versatility, and effectiveness.

(2) The accuracy of the mortar firing using live ammunition should be determined by following the procedures outlined in paragraph 11d, above.

15. Durability and Reliability.

a. Objective. To determine if the test mortar and test mortar trainer meet the durability and reliability criteria expressed in the appropriate requirements documents.

b. Method.

(1) During all test activities, special attention should be given to evaluating the durability and reliability of the test items.

(2) Special attention should be given during the entire testing program to the maintenance effort required during both the scheduled and unscheduled maintenance periods.

(3) The mean time between failures (MTBF) and the mean time to repair (MTTR) should be computed for both the test and control items.

(4) Special attention should also be given to repair parts usage.

c. Data Required.

(1) Breakage, excessive wear, and other indications of failure.

(2) A record of the scheduled and unscheduled maintenance data, to include:

(a) Detailed descriptions of the maintenance performed.

(b) Times required to perform the required maintenance.

(c) The number of cartridges fired before and after a maintenance period.

(d) The number of hours a test or control item was in use prior to failure.

(3) A record of repair parts usage, to include:

(a) Detailed descriptions of the parts failures.

(b) The number of cartridges fired prior to failure.

(c) The number of hours the test item was in use prior to failure.

d. Analytical Plan.

The data collected should be subjectively evaluated to determine if the stated durability and reliability criteria for the test items have been met, and if the test and control items differ significantly in their durability and reliability features.

16. Transportability (For Mortar Only).

a. Objective.

To determine the transportability characteristics of the test mortar, as they pertain to movement by combat-equipped soldiers, and to transport in the field both on tactical vehicles and in tactical aircraft.

b. Method.

(1) The test and control mortars should be broken down into 1-man loads and man-carried cross-country by TOE mortar squads for an appropriate distance. Standard load-carrying equipment should be used.

Transportation difficulties and any undue discomfort which can be attributed to the physical characteristics of the mortars should be noted.

(2) Test and control mortars should be emplaced in tactical mortar positions, and then, less associated equipment and ammunition, moved, if practicable, by one man for 200 meters over identical terrain. Any difficulties encountered during the movement should be recorded. This exercise should be repeated with each mortar by three different test soldiers, and then repeated with each mortar hand-carried by the appropriate crew.

(3) Both the test and control mortars, with all components, accessories, and ammunition, should be transported in tactical vehicles appropriate for the unit for a specified distance cross-country and along unimproved trails. Daily travel to and from the various test areas should also be logged and the total distance traveled during the testing program should be made a matter of record.

(4) When appropriate for a particular mortar being tested, delivery by parachutist should be conducted in accordance with the provisions of TOP 7-3-511, Airdrop Operations.

(5) The test and control mortars should be transported by appropriate aircraft in accordance with the provisions of TOP 1-1-041, Air Portability and Airdrop Service Testing.

(6) For mortars designed to be carried by one man, or in one-man loads, consideration should be given to using applicable portions of MTP 10-2-509, Combat Effectiveness Test Facility.

c. Data Required.

(1) Description of the test, and distance of the carry or vehicular movement.

(2) Conditions of the test, such as weather, terrain, time of day, visibility.

(3) Anthropometric data for the individual test soldiers, when deemed pertinent.

(4) Uniform worn and individual arms and equipment carried by the test soldiers.

(5) Method and position of carry, and carrying devices used.

(6) For items requiring two or more men for transporting, the following information should be noted:

(a) Number of men required.

(b) Load carried by each man.

(c) Variations tested.

(d) Relative merits of each variation.

(7) And difficulties encountered, and any malfunctions and breakdowns which can be attributed to transporting and rough handling.

(8) Pertinent comments of test soldiers, and results of interviews and questionnaires.

(9) Observations and comments of test supervisory personnel.

(10) Data acquired during the field exercises should also be noted.

d. Analytical Plan.

All collected data should be collated and analyzed, and then subjectively evaluated to determine whether the test mortar met the criteria expressed in the requirements documents, and if the test and control mortars differ significantly in their transportability features.

17. Maintainability.

a. Objectives.

(1) To determine whether the maintenance functions, as listed on the maintenance allocation chart, can be readily accomplished on the test items by using only the authorized maintenance manuals, tools, repair parts, and personnel skills.

(2) To determine whether the maintenance manuals are accurate and adequate.

b. Method.

(1) During the conduct of each supporting test, all scheduled and unscheduled maintenance functions should be performed using only authorized tools and procedures as specified in the maintenance manuals. A record should be kept of all scheduled and unscheduled maintenance periods.

(2) Operator maintenance should be performed by the test soldiers as the requirement arises.

(3) Direct and general support maintenance functions should be performed by soldier-mechanics who possess an MOS appropriate to the level of the maintenance effort being performed.

(4) Test soldiers and maintenance should be observed while performing the maintenance functions and they should be questioned to determine whether any maintenance function is unduly difficult, requires excessive time, or reveals discrepancies prejudicial to the ease of maintenance.

(5) All maintenance manuals issued with the test equipment should be analyzed for clarity, errors, and omission.

d. Data Required.

(1) The amount of operator maintenance performed on each test item.

(2) The amount of direct support and general support maintenance performed on each test item.

(3) The observations of the test soldiers, the test supervisory personnel, and the maintenance personnel regarding the ease or the difficulty of performing the proper maintenance procedures.

(4) Data regarding any errors or omissions in the maintenance manuals.

(5) Specific comments regarding the clarity and the overall adequacy of the maintenance manuals.

d. Analytical Plan.

All collected data should be subjectively evaluated to determine whether the test item met the criteria expressed in the requirements documents, and if the test and control mortars and mortar trainers differ significantly in their ease of maintenance.

18. Value Engineering.

a. Objective.

To determine if the test mortar or test mortar trainer contain any unnecessary or costly features which could be eliminated without adversely affecting the item's essential quality, reliability, maintainability, performance, or mission accomplishment.

b. Method.

Throughout the entire testing program, test supervisory personnel should attempt to identify any nonessential, nice-to-have accessories, components, or features which they feel could be eliminated without compromising the performance, durability, or safety of the test item.

c. Data Required.

(1) Test soldier's observations and comments, to include description of the particular feature, recommended changes, and their reasons for their recommendations.

(2) Test supervisory personnel onservations and comments, to include descriptions of the particular feature, recommended changes, and the reasons for the recommendations.

(3) Comments should be recorded in narrative form and should provide the fullest possible detail, to include photographs where necessary.

d. Analytical Plan.

All accumulated data, factual and otherwise, should be subjectively evaluated to determine if there are any unnecessary or costly features on the test mortar or test mortar trainer that could be eliminated without compromising the item's performance, durability, or safety. The evaluation should conclude with a recommendation for specific changes to be made to the test item, when such changes seem warranted and desirable.

Recommended changes to this publication should be forwarded to Commanding General, U.S. Army Test and Evaluation Command, ATTN: AMSTE-ME Aberdeen Proving Ground, Maryland 21005. Technical information related to this publication may be obtained from U.S. Army Infantry Board, ATTN: STEBC-MO-M, Fort Benning, Georgia 31905. Additional copies of this document are available from the Defense Documentation Center, Cameron Station, Alexandria, Virginia 22314. This document is identified by the accession number (AD No) printed on the first page.

APPENDIX A
REFERENCES

1. AR 70-10, Test and Evaluation During Development and Acquisition of Materiel.
2. AR 70-38, Research, Development, Test and Evaluation of Materiel for Extreme Climatic Conditions.
3. National Bureau of Standards Handbook 91, Experimental Statistics.
4. TECR 70-23, Equipment Performance Reports.
5. TECR 70-24, Documenting Test Plans and Reports.
6. TECR 310-3, Test Operations Procedures Style Manual
7. TECR 310-6, Test Operations Procedures.
8. TECR 385-6, Verification of Safety of Materiel During Testing.
9. TECR 700-1, Quality Assurance: Value Engineering.
10. TECR 750-15, Maintenance Evaluation During Testing.
11. TOP 1-1-012, Classification of Deficiencies and Shortcomings.
12. MTP 3-1-002, Confidence Intervals and Sample Size.
13. MTP 3-2-050, Mortars.
14. MTP 3-3-506, Accuracy and Precision.
15. TOP 3-3-600, Sight, Indirect Fire.
16. MTP 3-4-008, Arctic Environmental Test, Indirect Fire Weapons (Mortar).
17. MTP 10-3-506, Man Portability, Transportability.
18. FM 23-85, 60-mm Mortar, M19.
19. FM 23-90, 81-mm Mortar, M29.
20. FM 23-92, 4.2-inch Mortar, M30.
21. FM 23-91, Mortar Gunnery.
22. TM 9-6920-212-14, Subcaliber Mortar Trainer M32, with 25-mm Training Projectile M379.

APPENDIX B
TEST FOR CARRIER-MOUNTED MORTARS

1. In all tests, the standard carrier and carrier-mounted mortar should be used as the control item.

2. The objectives of these tests are to determine:

a. The physical characteristics of any modifications necessary to accommodate the test mortar to the standard carrier.

b. The safe field of fire available with the carrier-mounted test mortar.

c. The manipulation characteristics of the carrier-mounted test mortar.

d. The ease and safety of removing misfires from the carrier-mounted test mortar.

e. The time required to convert from the carrier-mounted role to a ground-mount position and to convert from the ground-mount position to the carrier-mounted role.

f. The accuracy of the carrier-mounted test mortar.

g. The maximum rate of fire of the carrier-mounted test mortar.

h. The stability of the carrier-mounted test mortar.

i. The durability of the carrier-mounted test mortar.

j. Adequacy of ammunition and fuze storage.

k. Adequacy of space for servicing the mortar.

3. Test Number 1, Physical Characteristics.

a. The test and control carrier-mounted mortars and accessories should be given a technical inspection in accordance with the maintenance package and placed in the best possible condition for the test program.

b. The vehicular mount adapter should be inspected for general ease of operation and accessibility of controls. The alignment and functioning

of the assembled weapon and of all sliding surfaces of the collar, yoke, and mortar tube should be checked. The major components should be weighed, measured, and photographed, and the assembled weapon should also be photographed mounted in the carrier.

4. Test Number 2, Safe Field of Fire.

a. The carrier-mounted test and control mortars should be laid in the center traverse position at the lowest possible elevation for mask clearance.

b. The mortars should then be rotated or traversed through 6,400 mils to determine the safety limiting points. The elevation should be increased in increments of 10 mils until the maximum safe elevation has been determined. The areas of mask clearance, referenced from the carrier, between minimum and maximum elevation should be plotted on polar coordinate paper. Firing should be conducted if necessary to verify the safe areas of fire.

5. Test Number 3, Manipulation.

The exercise used in paragraph 7 of the basic document, modified to conform to the safe limits of fire as determined above, should be repeated in this test.

6. Test Number 4, Removing Misfires.

a. Each member of the mortar crew should act as gunner and remove three simulated misfires from both the test and control mortars. Inert cartridges with dummy fuzes should be used during this test.

b. Removal time and any difficulties encountered should be recorded.

c. The removal times and any difficulties encountered in removing actual misfires during the firing phases of this test program should also be recorded.

7. Test Number 5, Converting Firing Positions.

a. The test mortar, located in a firing position a short distance from the carrier, should be dismounted and then mounted in the carrier. The baseplate and tripod assembly should be stored in the carrier, and the mortar tube should be assembled to the carrier elevating and traversing mechanism in a travel position.

b. The time and number of personnel required for the exercise and the ease with which the action could be accomplished should be determined.

c. This exercise should be repeated for a minimum of 3 repetitions, and an average time computed.

d. The exercise should then be repeated in reverse sequence, with the mortar being removed from its position in the carrier and placed in a firing position in a ground-mounted role.

e. The exercise should be repeated with the control mortar.

f. Test and control mortar carriers, with mortars in the travel position, should be moved to appropriate firing sites, engage in a firing exercise (including the handling of simulated misfires), and subsequently displace to new firing sites. Notation should be made of the time required to place the mortar in firing position on the carrier, the time required to accomplish the first fire mission, the time required to remove a simulated misfire, the time required to displace to the new firing site, and the time required to engage the second set of targets.

8. Test Number 6, Accuracy.

a. To determine the accuracy of the test and control mortars, appropriate numbers of cartridge-groups should be fired in exercises similar to those mentioned in paragraph 11b of the basic document.

b. Prior to beginning the firing exercises, the carrier should be positioned on a level surface. During the firing, the mortar crew and the driver, wearing fighting loads, will remain in the carrier. Ear plugs will be worn. Any adverse effects on the test soldiers caused by noxious fumes, overpressure, and the like, should be reported.

c. Tactical field firing exercises similar to those outlined in appendix C should be used to accumulate additional accuracy data.

d. Firing data should be evaluated as shown in paragraph 11d of the basic document.

9. Test Number 7, Rate of Fire.

a. The test mortar, carrier-mounted, should be fired at the maximum physical rate of fire for a specified time period without relay between cartridges.

b. The sight unit should not be removed from the mortar.

c. Cartridges should be fired in this exercise with the mortar set at the minimum safe elevation.

d. The firing exercise should be repeated with the control mortar also carrier-mounted.

10. Exercise Number 8, Stability.

a. The test and control mortars, carrier-mounted, should be fired in a series of exercises similar to those outlined in paragraph 8b of the basic document.

b. During these exercises, the mortars should be considered to be at 0 degree traverse when fired directly over the center of the rear of the carrier.

11. Test Number 9, Durability.

a. The test mortar, carrier-mounted and in the traveling position, should be driven over hard-surfaced roads, rough trails, and cross-country tracks for the distances specified in the appropriate requirements documents.

b. Special attention should be given to any breakage, excess wear, or looseness connected with the mortar.

c. At the completion of each travel phase, 25 cartridges should be fired at 0 degree traverse at an elevation to yield mid-range, and the results should be computed.

d. A detailed technical inspection of the mortar should be conducted when each firing exercise has been completed.

12. Throughout all testing periods, particular attention should be paid to the effect the test mortar has on the stowage of the mortar carrier, and on crew safety considerations. Specific observations should include, but should not be limited to, a consideration of the following items of interest:

a. Stowage which interferes with the firing of the mortar.

b. Whether the mortar components can be stowed adequately and securely, and whether they are easily accessible to the crew.

c. Blast effects encountered.

d. Hazards, such as sharp projections, obstacles to movement, and fire risks.

e. Fatiguing body positions during firing.

f. Any other stowage or safety problems introduced by mounting the test mortar in the standard carrier.

APPENDIX C
SUGGESTED TACTICAL EXERCISES

1. Seven different field exercises comprise this supporting test. The exercises include those situations that a mortar squad could expect to encounter in both offensive and defensive tactical situations. The exercises should be conducted with both the test and control mortars, and both mortars should be subjected to the exercises concurrently from the same general locations.

2. Exercise 1, Preparation for Defense.

The mortar squad, with mortar, accessories, and a basic load of ammunition, should load on a tactical wheeled vehicle and move under tactical conditions approximately 20 miles to an assembly area. In the assembly area, the mortar squad should establish local security, and should conduct the necessary preliminary preparations and planning to carry out defensive fire missions.

3. Exercise 2, Primary Defensive Position.

The mortar squad should move to a planned primary defensive position, emplace the mortar, and prepare to register. Prior to registration, enemy indirect fire (simulated) should be said to have destroyed the vehicle. This fire should also force the squad to displace by foot to a planned alternate position. (NOTE: A vehicle will be provided for use during the subsequent exercises).

4. Exercise 3, Alternate Defensive Position.

The mortar squad should complete laying the mortar, registering, and preparing fortifications in the alternate position.

5. Exercise 4, Defensive Fires.

a. The mortar squad should perform three fire missions during daylight hours. Each fire mission should consist of an adjustment phase which should require the gunner to relay the mortar at least four times, and a fire for effect phase which should consist of firing an appropriate sized cartridge group. Each of the three cartridge groups fired during the fire for effect phases should be fired as rapidly as possible, relaying the mortar after each cartridge during one, after every three cartridges during another, and without relaying during the third mission.

b. During one of the fire missions, the mortar squad should be subjected to a simulated attack in which toxic chemical agents should be represented by CS, CN, or Smoke, thereby forcing the mortar crew to perform the fire mission while wearing the protective mask and hood.

6 Exercise 5, Night Defense.

a. The mortar squad should be required to perform three fire missions during the hours of darkness. One of the missions will consist of the mortar squad firing its portion of one final protective fire mission; the other two missions should simulate normal defensive fires.

b. The barrage firing should consist of at least one 15-cartridge group fired as rapidly as possible without relaying the mortar and without exceeding the prescribed maximum rate of fire. The two defensive fire missions should consist of both an adjustment phase, which should require the gunner to relay the mortar at least four times, and a fire for effect phase, which should consist of an appropriate sized cartridge group.

c. One of the latter groups should be fired as rapidly as possible without relaying, while the other should be fired as rapidly as possible using traversing fire techniques.

d. Check rounds should be used to verify data prior to firing the barrage and other fire missions.

7. Exercise 6, Preparation for the Attack.

a. Following a briefing on an attack mission, the mortar squad should complete its necessary planning.

b. The mortar squad should move to an initial position during the hours of darkness to support a simulated Infantry attack. In this position, and while it is still dark, the mortar squad should lay its mortar, although registration and preparatory fires should be fired during daylight hours. Preparatory fires should use zone fire techniques.

8. Exercise 7, Targets of Opportunity.

a. The mortar squad should be required to displace by vehicle to a forward position to give continuing fire support to the simulated Infantry attack.

b. From the new position, the mortar squad should lay the mortar, register, and subsequently adjust to targets of opportunity.

c. Two 15-cartridge groups should be fired as rapidly as possible, relaying after every three cartridges.

COORDINATION

TOP 3-3-050 -- Mortars

The following is a list of the agencies with which this TOP was coordinated:

a. Commanding General, US Army Weapons Command, AMCPM-RES, Rock Island, Illinois 61201. No reply received. Concurrence is assumed.

b. US Army Arctic Test Center, STEAC-IN, APO Seattle 98733. No reply received. Concurrence is assumed.

c. US Army Human Engineering Laboratory, AMXHE-SYS, Aberdeen Proving Ground, Maryland 21005. No reply received. Concurrence is assumed.

d. US Army Ballistics Research Laboratories, AMXBR-WD, Aberdeen Proving Ground, Maryland 21005. No reply received. Concurrence is assumed.

e. US Army Infantry School, ATSIN-I-M, Fort Benning, Georgia 31905. Reply received. Concurred without comment.

f. US Army Combat Developments Command Infantry Agency, CDCIN-CM, Fort Benning, Georgia 31905. Reply received. Concurred without comments

g. US Army Field Artillery Board, STEBA-MO, Fort Sill, Oklahoma 73503. Reply received. Concurred without comment.

h. US Army Armor and Engineer Board, STEBB-MO, Fort Knox, Kentucky 40121. Reply received. Concurred without comment.

i. US Army Tropic Test Center, STETC-OO-P, APO New York 09827.

Comment. In Paragraph 6a, add the word "any" and delete "the" before the word "problems", because the present wording indicates problems are expected.

USAIB Accommodation. Concur. Paragraph 6a has been changed to reflect the comment.

Comment. In Paragraph 6b(2)(b), the phrase "when sufficient data" needs clarification. From what source document can the test officer refer to, to determine when he has sufficient data?

USAIB Accommodation. Nonconcur. That is the purpose of consulting with a statistical analyst, as is pointed out in Paragraph 4.

j. US Army Yuma Proving Ground, STEYP-MMI, Yuma, Arizona 85364.

Comment. In Paragraph 9b(2)(d), suggest that specific soil conditions be required rather than the word "varied." In Paragraph 9b(4), the descriptive terms "sand", "mud", and "very hard ground" are used to specify soil conditions.

USAIB Accommodation. Concur. Paragraph 9b(2)(d) has been changed to reflect the comment

k. US Army Aberdeen Proving Ground, STEAP-MT-M, Aberdeen Proving Ground, Maryland 21005.

Comment. In Paragraph 9b(3), change wording to read: "Note the total vertical and horizontal baseplate during seating and during the firing exercises and sight throw-off during the firing exercises." The sight should not be on the mortar during seating.

USAIB Accommodation. Concur. Paragraph 9b(3) has been changed to reflect the comment.

Comment. Reference Paragraph 12c(2)(e), page 29, taking range and deflection on each round in a maximum physical rate situation is very difficult. Suggest that some details be given as to how this could be accomplished.

USAIB Accommodation. Nonconcur. This subparagraph refers to measurements of each "cartridge group" not of each "cartridge". Group measurements can be made, as indicated in the supporting test.

l. US Army Airborne, Communications and Electronics Board, STEBF-BO, Fort Bragg, North Carolina 28307.

Comment. In Paragraph i, change ". . . and twilight, 1×10^{-1} to 10 foot candles" to read" . . . and twilight, 1×10^{-4} to 1 foot candle." 1 to 10 foot candles pertain to dawn or dusk and not twilight.

USAIB Accommodation. Nonconcur. By definition, twilight includes both dawn and dusk. The Infantry Board prefers to use dawn and dusk as specific parts of twilight, and to list them as separate items for measurement purposes.

Comment. In Paragraph 4, page 6, delete ". . . because of its newness, or . . ." A test item will not be degraded purely as a result of its newness, but rather because the test troops were unfamiliar with the test item.

USAIB Accommodation. Concur. Paragraph 4 has been changed to reflect the comment.

Comment. In Paragraph 16b(5), change wording to read " . . . by appropriate aircraft in accordance with the provisions of TOP 1-1-041, Air Portability and Airdrop Service Testing."

USAIB Accommodation. Concur. Paragraph 16b(5) has been changed to reflect the comment.

Comment. In Appendix C, add provisions for airtransport and airdrop in maneuver exercises.

USAIB Accommodation. Nonconcur. The exercises shown are suggested exercises only and are not intended to be all-inclusive. A test officer is free to develop his own exercises as needed to meet his own test requirements.